Breton Island, appending various explanatory remarks which should prove useful to students attempting to make similar applications to other regions.—GEO. D. FULLER.

Permeability.—Several interesting contributions to our knowledge of protoplasmic permeability have appeared recently. DELF[12] has investigated the influence of temperature on the permeability of protoplasm to water by the tissue shrinkage method, using sections of onion leaves and dandelion scapes in subtonic solutions of cane sugar. The curve of contraction at different temperatures was measured by means of an optical lever which greatly magnified the shrinkage, and from this curve the rate of contraction at the time when 30, 50, and 70 per cent of the shrinkage had occurred, was measured by the tangents to the curves at these points. From the rates the values for Q_{10} were obtained. This value increases as the temperature rises. In the onion leaf the value of Q^{10} at 10–20° C. is 1.5, at 20–30° C. is 2.6, and at 30–40° C. is 3.0. In the dandelion scape the greatest value of Q_{10} was obtained at 20–30° C., at which temperatures it was 3.8. Above and below those temperatures the value falls. Contrary to the results of VAN RYSSELBERGHE, who found very little increase in permeability above 20° C., DELF finds that permeability of the protoplasm to water continues to increase rapidly up to the highest temperature investigated, 42° C. The methods used by VAN RYSSELBERGHE are justly criticized, particularly with reference to the means of deriving a temperature relation from his data. The strength of solutions used by VAN RYSSELBERGHE may also have led to serious errors.

Miss HIND[13] has studied the absorption of acids by living plant tissues, using electrical conductivity methods, and electrometrical measurement of the H^+ ion concentration in acid solutions which were in contact with living potato disks and roots of *Vicia Faba*. She found that the hydrogen ion is rapidly absorbed from dilute acid solutions by living tissues, and concluded that the anion, particularly in organic acids, plays a large part in determining the effects of the acid on protoplasm. In the case of the mineral acids, HCl, HNO_3, and H_2SO_4, the stronger solutions can penetrate the cells for a time without causing much injury as measured by exudation of electrolytes; but organic acids like formic and acetic cause very rapid increase in conductivity, due to exosmosis of electrolytes from the cell. With these two acids there is first a decrease and then after a few hours a very noticeable increase in H^+ ion concentration. This is thought to be due possibly to the production of acids within the tissues which diffuse out through the altered plasmatic membrane.

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[12] DELF, E. MARION, Studies of protoplasmic permeability by measurement of rate of shrinkage of turgid tissues. I. The influence of temperature on the permeability of protoplasm to water. Ann. Botany **30**:283–310. 1916.

[13] HIND, MILDRED, Studies in permeability. III. The absorption of acids by plant tissue. Ann. Botany **30**:223–238. 1916.

As to the mechanism of absorption, a few experiments furnish evidence favoring the idea that the plasmatic proteins rather than the lipoids are active in the acid absorption.

A very important paper by STILES and JØRGENSEN[14] challenges not only the theory of permeability proposed by CZAPEK some years ago, the surface tension theory, but also all the facts and assumptions upon which that theory was founded. Because of its greater exactness and more general applicability to a study of all kinds of plant tissue, the Kohlrausch electrical conductivity method of estimating osmosis of electrolytes was used as a means of measuring changed permeability. Disks of potato were placed in non-electrolytic reagents of such strength as to produce irreversible changes in the protoplasm. Exosmosis of electrolytes was measured in the presence of a number of homologous monohydric alcohols, chloroform, chloral hydrate, ether, urethane, acetone, aniline, and pyridine. In all cases corrections for the depression of conductivity caused by the presence of the non-electrolyte in the external solution were made. In every case the rate of exosmosis was found to depend upon the concentration of the substance in solution in contact with the disks. The higher the concentration the more rapid the exosmosis, and CZAPEK's observation that any member of the homologous series of primary alcohols has a greater effect on osmosis than a lower member of the series, if of equimolecular concentration, is confirmed. No such thing as a critical concentration, however, below which exosmosis did not occur and above which it did occur, could be found. Exosmose of electrolytes occurred in all concentrations used, down to mere fractions of the critical concentrations for exosmosis found by CZAPEK's crude methods. The rate of diffusion of electrolytes was found not to be a function of surface tension alone. If the critical concentration of isobutyl alcohol were to be taken as 0.3 M. and the other alcohols compared with it as to equal exosmosis in a given time, the surface tensions of the various alcohols do not agree at 0.68 of the surface tension of water, as CZAPEK stated, but vary from 0.79 in methyl alcohol to 0.59 in isoamyl. The higher the alcohol the greater the lowering of the surface tension required to produce a given amount of exosmosis in a given time. Each item of evidence and the whole tissue of assumptions upon which CZAPEK built his theory of the plasmatic membrane is considered in detailed fashion and without gloves. The authors reject each point and assumption as untenable. In their own words, "from this review of the details of Czapek's work on the plasma membrane, it is clear that neither the experimental evidence nor any part of the theory based upon it can be accepted." They have sought to apply the law of mass action to the rate of osmosis in cases of permeability involving irreversible changes in the protoplasm, and a mathematical expression has been deduced connecting the time

[14] STILES, WALTER, and JØRGENSEN, INGVAR, Studies in permeability. IV. The action of various organic substances on the permeability of the plant cell, and its bearing on CZAPEK's theory of the plasma membrane. Ann. Botany **31**:47–76. 1917.

element with exosmosis. Curves representing the equation derived thus on theoretical grounds resemble in type those obtained in actual experiments. The methods used in this work seem admirably adapted to a crucial test of CZAPEK'S theory, which seems entirely untenable in view of the evidence submitted.—CHARLES A. SHULL.

Desiccation.—An investigation of the course of desiccation and partial starvation in cacti has been made by MACDOUGAL, LONG, and BROWN.[15] The principal studies center upon the changing rate of water loss, chemical changes in the food reserves, plasmatic colloids, and cell sap, and the morphological changes which occur during long periods of desiccation. In one case a large *Echinocactus* was under observation for 6 years after removal of the plant from the soil. Water loss is rather rapid at first, but proceeds more and more slowly with time. While 10 per cent of the water was lost the first year in one specimen, during the sixth year only 5 per cent of the water remaining at the beginning of that year was lost. The loss of water is much more rapid of course in the open than in diffuse light and *Echinocactus* can withstand desiccation not more than 2 years with free exposure.

The chief chemical changes noted during the starving period concern the carbohydrates. The density of the cell sap decreases, due to disintegration of the carbohydrates, and the reducing sugars are found mainly in the inner part of the cortex in desiccated specimens rather than near the surface as in normal plants. The total amount of reducing sugars decreases during desiccation, while non-reducing sugars are increased noticeably in the cell sap. Reduction of the amount of sugars leads to reduction of acidity if the light intensity is sufficient for photolysis of the acid. In weak light even, if the sugars run low, the acids may accumulate because of the absence of photolysis. Differences in acidity are thought to be partially responsible for differences in the colloid hydration and swelling of tissues when placed in water.

The main morphological changes consist in thickening of the cuticle, thinning of the anterior walls of the guard cells, partial destruction of the plasmatic colloids, shrinkage in the size of the nucleus, and especially the development of cortical lacunae through hydrolysis of the cell walls of this region of the stem. The vascular tissues are not affected, and the medullary cells much less than the cortical cells.—CHARLES A. SHULL.

The vegetation of Michigan.—From the data obtained during a few weeks in Michigan, HARPER[16] has listed the principal plants in the order of their abundance and has discussed certain features of the environment. He recognizes but two types of succession, the one from the filling up of lakes and other

[15] MACDOUGAL, D. T., LONG, E. R., and BROWN, J. G., End results of desiccation and respiration in succulent plants. Physiol. Res. 1:289–325. 1915.

[16] HARPER, R. M., The plant population of northern lower Michigan and its environment. Bull. Torr. Bot. Club 45:23–42. 1918.